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Procedia Computer Science 27 (2014) 334 – 342

Procedia Computer Science

5th International Conference on Software Development and Technologies for Enhancing Accessibility and Fighting Info-exclusion, DSAI 2013

Guidelines for search features development - a comparison between general users and users with low reading skills

Débora Maurmo Modesto, Simone Bacellar Leal Ferreira*

Universidade Federal do Estado do Rio de Janeiro (UNIRIO) - Departamento de Informática Aplicada, Av. Pasteur, 436, Urca, Rio de Janeiro,22290-240, Brasil

Abstract

The lack of reading skills affects the way users search on the Web or interact with computer interfaces. Developers and designers must comprehend these users' limitations in order to provide features that meet their needs and help them to have a better experience on the Web when using search features. In this work we analyzed the interaction of users with low reading skills with a limited set of search features. Their behavior and preferences were compared to general users' behavior on search interfaces retrieved from literature. These comparison permitted to identify related issues and create a set of common recommendations.

Keywords: Low reading skills; low literate users; search features; recommendations, search engines.

1. Introduction

The most usability problems on the Web are related to finding, reading and understanding information [1]. People with low reading skills have these problems magnified due to lack of language skills, so it is characterized

* Corresponding author. Tel.: +55-21-87775608.
E-mail address: debora.modesto@uniriotec.br

doi:10.1016/j.procs.2014.02.037

also as an accessibility issue. The lack of these skills affects the way people manage daily life aspects, as communicating with other people, comprehending texts in the school or in the job [2] and even interacting with computer interfaces as search engines [3][4]. These kind of interfaces are used to retrieve Web content, that is predominantly textual, but are also used to retrieve other kind of media [5]. The Web represents an important role in people's life, mainly for people with disabilities [6]. Therefore, users with low reading skills could benefit from the Web using tools like search engines, but they have some peculiarities that should be considered on the design and development of these tools, as limitations related to perception and search strategies [3][4] and the use of search tools differently from users with high reading skills [7][8].

In this research we conducted user tests with Brazilian users in order to observe people with low reading skills interacting with a predetermined set of search engine features. We aimed to identify how these features affected users' experience. A questionnaire and an interview were also performed. After this analysis, we compared the behavior and preferences of the users with low reading skills with general users' behavior retrieved from literature. From this comparison we could identify which issues are common to users with low reading skills and users in general and create a list of recommendations that are consistent with both users' needs.

2. Web Accessibility

Web Accessibility is the use of Internet resources and access to information without barriers, regardless of cognitive, perceptual or physical capacities of a person. There should be no architectural, physical or communication barriers which could hinder access to resources and information on the Internet [9][10]. When it comes to features provided by search engines or search tools in a site, it should not be different.

3. Reading Skills

There are many reasons why a person may be unable to fully understand the meaning of a text. It can be caused by a decoding deficiency, an attention deficit, poor vocabulary, lack of knowledge base, weak language processing skills, weak memory and so on [11][12].

People to whom lack oral, reading and writing skills, besides abilities with logic, mathematics and symbolic analysis, that cannot apply these skills on daily life are usually called functional illiterates [13]. There are different approaches to conceptualize functional illiteracy. The United Nations Educational, Scientific and Cultural Organization (UNESCO) considers schooling as a criteria. This organization considers functional illiterates people between 15 and 64 years old, which lack mastery of skills in reading, writing, calculations and science, corresponding to an education of less than four years of study [13][14]. In Brazil, the same criteria is adopted by federal agencies as Brazilian Institute of Geography and Statistics (IBGE).

In this research we use the same criteria as UNESCO and IBGE, but we call participants as users with low reading skills, once a protocol used to guide the study recommended not to call them functional illiterates [8].

3.1. How Low Reading Skills Affect Users' Experience on Web Search

Previous studies identified information seeking behaviors of low and high literacy users. Usually, users with low reading skills are not able to perform a superficial reading of any text, that means, when they need to read outcomes from a search they read carefully every word, but not necessarily understanding what they are reading [15]. They also don't feel comfortable reading and navigating in pages full of information and links. It contributes to the fact they don't check if an information is correct [3]. As reading is not an easy task for them, once they find something they consider to be the information they need or if they take some time to find what they want and fail, they abandon search task [3].

If compared with users with high reading skills they have more difficulty to recover from errors, usually due to their poor ability to change search strategie. Refinement of searches through modifying search strategy is more difficult to them as well. They usually take more time to finish search tasks, stay longer on the same page and visit

more pages than users with high reading skills once they are unable to completely comprehend the meaning of too many information at the same time. All these behaviors affect users' performance [3].

Users with low reading skills need features that supports them on decisions about relevance of results presented by search engines and which outcomes to choose. A study indicates that supporting decision about outcomes is more important than supporting these users to write a query [16].

4. Methodology

This was a qualitative and exploratory research and consisted mainly of user tests that took place in Rio de Janeiro, Brazil. The research was divided according to the following steps: (a) Select participants; (b) Define a search engine and a limited set of search features for analysis; (c) Define strategies to conduct tests; (d) Execute tests; (e) Analyze results; (f) Compare data with guidelines already known, in order to find out similarities with the work findings; (g) Create a list of recommendations to support development of search features in compliance with users' with low reading skills needs and general users' needs.

Six men and four women were recruited mainly in schools with youth and adults education classes, churches and residential buildings. Recruiting occurred based on UNESCO and IBGE classification, that means that all participants were between 15 and 64 years old and had less than four years of study on formal education. Besides that, participants answered a questionnaire that had questions about their skills on the Internet and their perception about their experience with search engines. This questionnaire allowed us to obtain more information about users' profile. It helped us on recruiting, once we choose users with similar experience on the Internet to minimize possible biases caused by criteria adopted, that considered a wide age range. Eight users had less than two years of experience with internet and two had less than five years.

Questionnaire also showed that all participants were used to search using Google search engine, so we selected these tool for analysis. It was also a widely used tool in Brazil and in all the world [17][18][19][20]. A limited set of features from these search engine were selected for analysis and a set of interaction aspects were also observed. We divided them into categories as follows:

- Reading, writing and query formulation features: auto complete, spell checker, related searches, advanced search and filters.
- Orientation and navigation features: layout (header, search bar, advertisements, pagination and footer), search outcomes, keyboard navigation and "I'm feeling lucky" button.
- Feedback features: Google Instant features (page and result preview).
- Interaction aspects: simplicity of the text, amount of terms used, how they elaborate a query, perception and orientation.

In order to define strategies to conduct the research (planning, preparing, conducting and reporting results) we opted to use two consolidated protocols: the "Protocol for conducting usability testing with a focus on accessibility" [21] and "Protocols for Web accessibility evaluation involving functional illiterates" [8]. Besides these protocols, we adopted a checklist for plain writing for Web to help us preparing all textual material used on the tests [22].

User tests were performed in two phases, each one with five users. The first phase goal was to explore features observing users' behavior, which features would be used and their preferences. After the tests on this phase, each feature was presented to users through explanations and examples. After that, an interview was conducted in order to know their opinion about features (if they like it, if they had already used it and if they thought it was useful).

The second phase goal was to explore features not used on the first phase, since users did not know they existed or were not sure about how they worked.

Results were analyzed and a list of recommendations were created based on observation. Items were grouped in the same category we used to group features: "reading, writing and query formulation", "orientation and navigation", "feedback", "interaction aspects".

A comparison was made between recommendations created focused on users with low reading skills and recommendations that address general users' needs found in the literature.

4.1. Limitations

Considering only schooling and not considering extracurricular capabilities can be a limited approach. If other criteria were used to recruit participants, maybe other results could be found. However, there are no mechanisms for public use that allow us to classify participants using other criteria.

5. User Tests

Tests were executed in a portable lab and consisted of two phases, each one performed by three men and two women. On the first phase, users executed five tasks and were encouraged to explore Google search features. Each task presented scenarios that contextualized the user in the search problem. Tasks addressed the following goals:

- to find a specific characteristic of a product (from a predetermined bicycle brand).
- to find site address (URL) of the Traffic Department of the State of Rio de Janeiro (DETRAN-RJ), the institution responsible for issuing identity cards and driver license.
- to find and download a PDF booklet with the rules of a Brazilian government housing program known by the participants.
- to find the maximum income a person should have to enroll in a Brazilian government program of direct cash transfers to poor families.
- to find the year in which the new Portuguese Language Orthographic Agreement took effect in Brazil.

First three tasks were considered easy once they did not involve inferences, advanced knowledge or domain specific vocabulary. The fourth task was considered of average difficulty, since it involved magnitude notions, such as minimum and maximum, as well as more advanced vocabulary. The fifth task was considered difficult because it involved notions of current facts and more ability to interpret the results.

According to the protocol adopted [8], time for concluding tasks should be predetermined even if users were not able to finish all tasks. After the test, the researcher asked questions related to perception about the interface and the features analyzed. Participants indicated whether they knew the feature demonstrated, if they had already used each feature and their impressions about utility and usability.

Advanced search and filters were not used on the first phase by any participant, but were considered useful during the interview, so were tested on the second phase. Two tasks with different goals were performed. A short video explaining how to use these features were presented to users before each task. On these tasks users should:

- use advanced search to find the value of the service tax to be paid to DETRAN-RJ to make a second copy of identity card.
- use filters to find "Dom Casmurro" book, a literature book from Machado de Assis (a Brazilian author).

6. Data Analysis

First, data from questionnaires and interviews were analyzed. Half of the participants stated they usually ask for help when using search engines. Eight indicated that knowing if a word is spelled correctly is the major difficulty. Result analysis was considered a difficult task by six participants, but in general, participants stated they had no difficulties in the formulation of a query (seven answered this way). When asked about how they think they usually perform on search tasks they think they do it well and usually find what they look for.

We could notice that maybe there is a relation between this sensation of performing well and the kind of subject they look for. Eight users mentioned that most of their searches are related to products, followed by music and videos (both mentioned by seven participants). This kind of search results in different type of media as outcomes like images, audio and videos, that means non-textual feedback for users.

When executing search tasks that required more reading, they did not performed well. On the first phase, we observed that only two from five users successfully completed each of the first three tasks. The fourth and fifth tasks were not completed by anyone.

On the second phase, users should complete the task using features presented (advanced search and filters). Four users successfully completed the first task, but only one participant used advanced search feature, even after explanation about its operation. Second task was successfully completed by only one user, that did not used filters feature. The participant who used filters failed to finish the task.

6.1. Reading, Writing and Query Formulation

This section presents considerations regarding the following features: auto complete, spell checker, related searches, advanced search and filters.

Besides difficulties users faced to formulate a query, they faced obstacles related to spelling words. Auto complete feature helped users to verify the correct spelling of a word while they were typing. However, sometimes terms presented were not related to search goal and users were not able to choose terms that configure better approaches. Some users couldn't see terms suggested by spell checker, since they didn't have skills to type and look at the monitor at the same time.

As mentioned before, users have difficulties to identify the correct spelling of a word. It was expected that search engine has a default behavior to consider terms corrected on the search, even the user typed it incorrectly. Spell checker benefited interaction but correct words were not always noticed.

The related searches features benefited users when it was used. It supported users on refinement of a query and even changing strategy with new terms. Despite using this feature in a positive way, most users stated they preferred to refine query manually, that means, writing terms instead of selecting it on a list.

Advanced search features confused the only user who try to search through it. This feature has a lot of fields that can be used to search and requires advanced knowledge about search engine operation.

Filters were not often used but presenting outcomes filtered with the same format and color from regular outcomes confused users. Users stated that filtering outcomes after they are displayed affects their search performance, but selecting a category or filter before typing the query was not considered a problem.

6.2. Orientation and Navigation

This section presents considerations regarding the following features: layout (header, search bar, advertisements, pagination and footer), search outcomes, keyboard navigation and "I'm feeling lucky" button.

The search page didn't represent a barrier. However, a users mentioned that he would appreciate if the tool provided some instructions about how to start a search.

Categories menu was displayed on the pages' header and was not used by anyone. However, one user stated that he often used that feature when searching for videos.

One user present difficulties with the size of search field. After writing lots of terms, the first words become hidden. It confused user mainly when he wanted to refine the query by adding new terms. As he could not see what was already typed, he started to type more words forming a meaningless sentence.

When outcomes were displayed, most users looked at title, some look at the description but anyone visualized the URL nor used this information to evaluate site credibility. Words highlighted in bold, in both title and description, helped users to keep focused on the problem. Description was composed by snippets extracted from parts of the target site. There are suspension points between every two snippets. When users read the description they could not understand that were not a unique statement.

When users were asked about the order of the outcomes presentation, they sad they did not know position indicated relevance. Therefore, when they analyzed results, they read every outcome not only the first ones. Most users visualized outcomes on the first page and did not navigate to other result pages.

One user stated that amount of outcomes was excessive and that confused him.

Advertisements were displayed with a similar format and colors of common outcomes. It confused users that selected advertisements thinking they were regular outcomes.

Anyone used keyboard navigation since they have more familiarity with the mouse.

6.3. Feedback

This section presents considerations regarding the following features: Google Instant (page and result preview).

Result preview was not noticed by most of participants. In general, these users are not able to transfer attention from a subject to another very fast. While typing the query, they could not focus on results being presented. This feature did not influenced interaction regarding to provide feedback as soon as possible. However, once a word was typed on search field results were prominently displayed. That minimized the necessity to choose which button to select after typing the query (Search button or "I'm feeling lucky" button).

Anyone used page preview feature. They stated that was not possible to understand the content of the target page since text and images were too small.

6.4. Interaction Aspects

This section presents considerations regarding the following aspects: simplicity of the text, amount of terms used, how they elaborate a query, perception and orientation.

Regarding to simplicity of the text and amount of terms used we observed that query was simple when users were searching for a simple subject of an easy task. When they need to explore a theme or solve complex problems the query was similar to a question or request for a human. In this cases, they increased the amount of words used. Comparing the amount of terms used on the first test by users we observed the following data: first user typed between five and twelve terms; second user typed between six and fourteen terms; third user typed between one and seven terms; fourth users typed between two and four terms; fifth users typed between two and ten terms.

Some of them stated that they would like if search engine outcomes were not like text blocks where they need to seek for information. They would like to receive a direct answer, as it was given by a human.

Formulate the query was a problem since its the basis for all search process. If the search problem is not clear and the query doesn't represent user's goals, results are affected. This behavior was observed on the test: users with low reading skill have difficulties to adopt strategies that could lead them to good results. For example, when performing the test an user typed "www" before every query, due to lack of experience and knowledge about the operation of search engines.

When users need to refine a query, most of times they added terms instead of changing search strategy. They feel more comfortable to change search strategy when performing easy tasks.

When executing searches that lead to an action, like downloading a file, the action was a term of the query.

A common habit of these users is trying to find information directly on page results instead of going to a site and seeking information there.

Orientation on the pages were not a problem. Even when they made mistakes they did not get lost on the page, but get confused regarding to the search problem.

They did not demonstrate difficulties to navigate between search pages, outcomes and target sites. Any user visited the same site more than one time and they returned to search page only a few times. Once they thought an information was correct they did not confirmed it in other sites.

7. Comparing Users' Needs

Nielsen and Loranger [1] listed some behaviors and needs for general users. Some of these behaviors could also be observed during the present work with users with low reading skills. For example, they mention that search engines are becoming "answer engines", that means that instead of exploring and seeking information in deep site structures, users demand quick answers from search engines [1]. This will could be noticed in this research because users stated they looked for answers on the result page. They did not want to explore a site to seek for information.

Another common behavior is looking for information only on first results page [1].

Nielsen and Loranger [1] indicate that larger search fields are better because they encourage users to write longer queries, leading to more accurate results and minimizing mistakes. This recommendation applies also for users with low reading skills.

Their study recommends making available spell checker for general users [1]. Providing a spell checker feature is very interesting for users with low reading skills once they also have low writing skills.

There was a recommendation not to display complex URLs because some users could extract information from there. However, general users are not analyzing it anymore as they were used to do [1]. A situation where general users sometimes analyze this information is when they are looking for a specific organizational page [15]. Considering that users with low reading skills rarely see the URL, it is an evidence that it could be displayed only on demand.

When filtering or restricting results, Nielsen and Loranger [1] recommended to make global search default, allow access to it through one single click and declare the search scope. In the present work we identified that if filters were used results should be clearly identified by their categories, otherwise, users with low reading skills can be confused.

Regarding to results' relevance Nielsen and Loranger stated that it is not necessary to provide relevance indications [1]. Keane *et al.* [23] and Bar-Ilan *et al*. [24] indicated that general users are usually influenced by suggested results' relevance, identified through positioning. Maybe should be a good approach to provide some indication when dealing with the target audience of the present work, once they have great difficulty to identify which result provides the information they are looking for and do not understand that positioning means relevance.

Regarding to the amount of terms used to search, general users often use around two or three words [1]. Users with low reading skills have difficulty to elaborate search strategy and usually type lots of terms that varied from one to fourteen words in this research.

General users tend to ignore advertisements when its format clearly looks like advertisement [1]. Google search engine displays advertisement using the same format as regular outcomes (also called organic results). Users in this research did not ignored advertisement and thought they were organic results. It is good for advertisers but it is bad for users with low reading skills.

Some other works addressed general users' behavior when using search engines. General users usually focus on the title and description of a search result when they have a search goal that implies in exploration of a subject. Users with low reading skills usually focus on the title of the result, but sometimes look at description too. Highlighting search terms in the title and description is a good approach to maintain these users focused on search problem.

For general users, images are an expected type of media. Videos can distract users since comprehend its full meaning quickly is not possible [15]. Regarding to users with low reading skills, other kind of media can affect interaction, so it is good to present it separately or when user demand it.

If general users do not find what they want on first results, they tend to perform another search [24]. Users with low reading skills have a different behavior: they tend to read almost every content on the page until they decide to refine their search.

Another study stated that only a few users know how to use advanced features [25]. In general, users with low reading skills do not know how to use it either.

A work about terms suggestion showed that most users preferred to refine the query manually [26]. In the present work users refined the query manually and using related searches, but they indicated their preference for manual refinement.

General users usually do not know how the search engine works. It creates incorrect expectations about outcomes [27]. The same happens with users with low reading skills. Explanations presented about how search engine works would help users to understand outcomes.

8. Recommendations for Search Engine or Site Search Tools Development

Based on user tests and comparisons with previous works, a list of recommendations were developed in order to help developers and designers to create or improve search tools:

- Provide large search fields.
- Provide features that support writing, query formulation and refinement.
- Provide features that support better results analysis without hinder performance.
- Display search results with title and description and highlight search terms on them. Other information can be displayed on demand.
- Provide filter or category features, but clearly identify which result belongs to which category.
- Provide relevance indications (not only ranking or positioning) if interface can be used by users with low reading skills.
- Provide evidences that some results are advertisement not organic results.
- Display different kinds of media results only if user requests or in a separate area of the page.
- Do not highlight advanced features. They can exist, but must be displayed only on demand.
- Provide small tips about how to operate search engine.
- Minimize distractions, providing ways to let user focused on one activity at a time.
- Provide feedback.

These recommendations still need a validation, but they are consistent with general users' needs and supports also users with low reading skills.

Some of these recommendations were already implemented by Google search engine, but some of them were not addressed yet and could be developed and tested on the interface. For example, presenting less valuable information on demand (as URL), clearly identifying filtered results, providing relevance indications (not only through page ranking), differentiating advertisements from organic results, presenting non-textual media in separate areas and providing tips about how to operate search engine are recommendations that could be explored on this tool.

9. Conclusion

This research aimed to identify how users with low reading skills interact with search features in order to compare their needs, behavior and preferences with the same aspects related to general users' collected from previous works. We analyzed the interaction of users with low reading skills with a limited set of search features through user tests, interviews and questionnaire. Their behavior and preferences were compared to general users' interaction with search interfaces retrieved from literature. We identified common issues that could be addressed using the same solution for both kind of users and created a set of common recommendations. These recommendations still need a validation, mainly regarding users with low reading skills. Other tests can be performed as comparing interaction in the same search engine, not only comparing data found with previous works, comparing the use of different search engines, or implementing this recommendations and testing their validity.

We expect these recommendations help developers and designers to create or to improve search engines and search tools from their sites.

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